GEANT Simulation of the Small Dipole Ring – status report

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Outline

- A reminder:
  - The simulation code
  - The small dipole ring
  - What has been presented at Berkeley (not much)
- New results:
  - Constant energy behavior (only magnetic field on)
    - Dynamic aperture – transverse acceptance
    - Reference orbit
  - The ring with RF and "ideal" absorber (no scattering)
    - Longitudinal acceptance
    - "Perfect" cooling

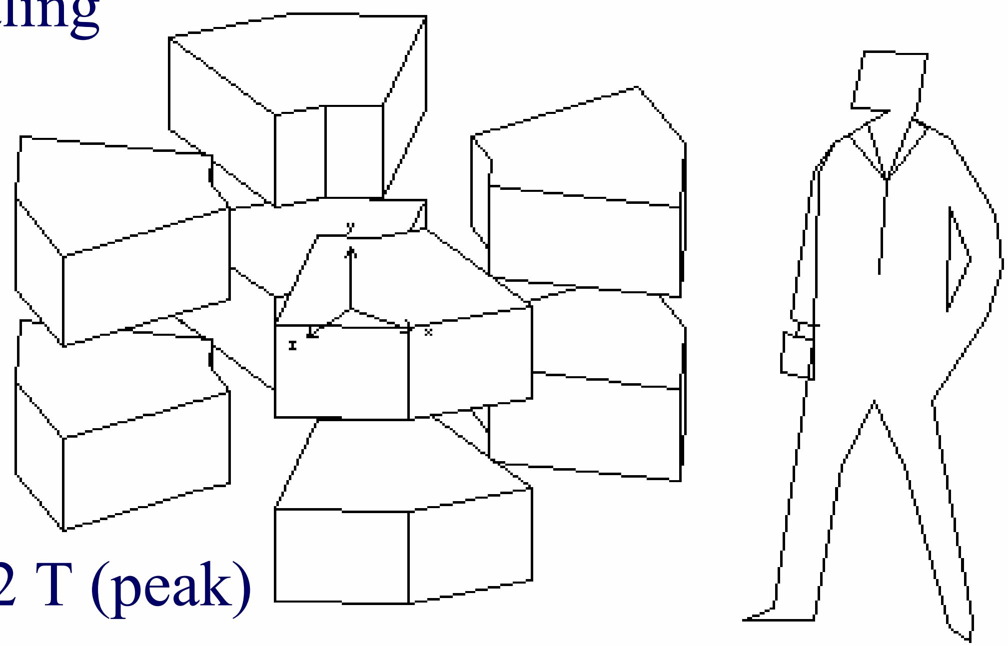
Simulation software

- MUC_GEANT
  - Data-driven GEANT 3.21 (from R. Raja) similar to the one used for the RFOFO ring
    - Interface with ICOOL input/output, ECALC9
    - NEW perfect pillbox cavity (Bessel function)
  - Field maps from Steve Kahn, using shaped iron poles

6D Cooling demonstration Ring

"Weak" (edge) focusing
(ideally) scaling

Filled with
~10 Atm.
hydrogen
gas (77K)

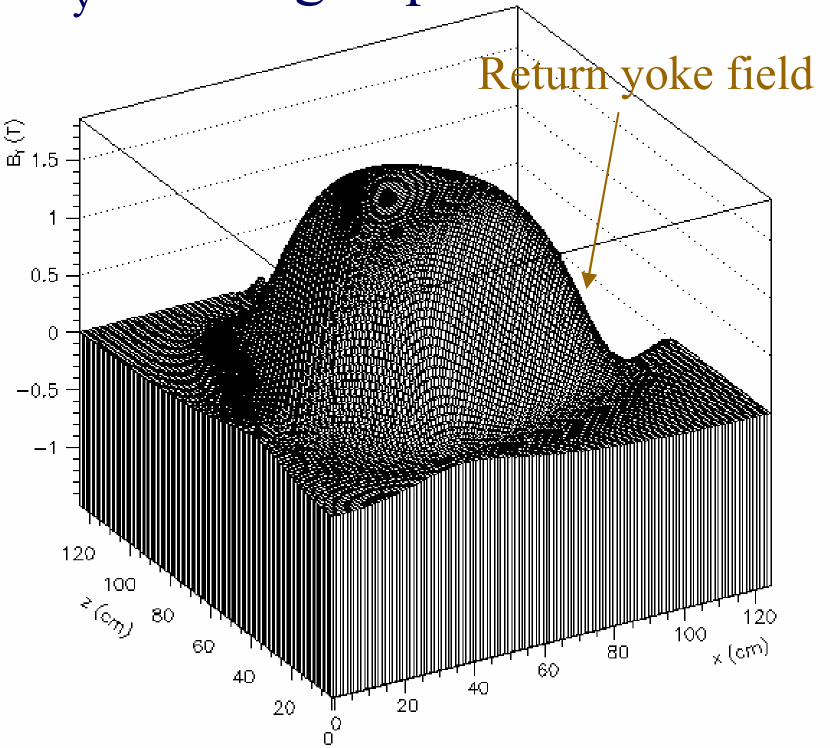


Dipole B ~ 2 T (peak)

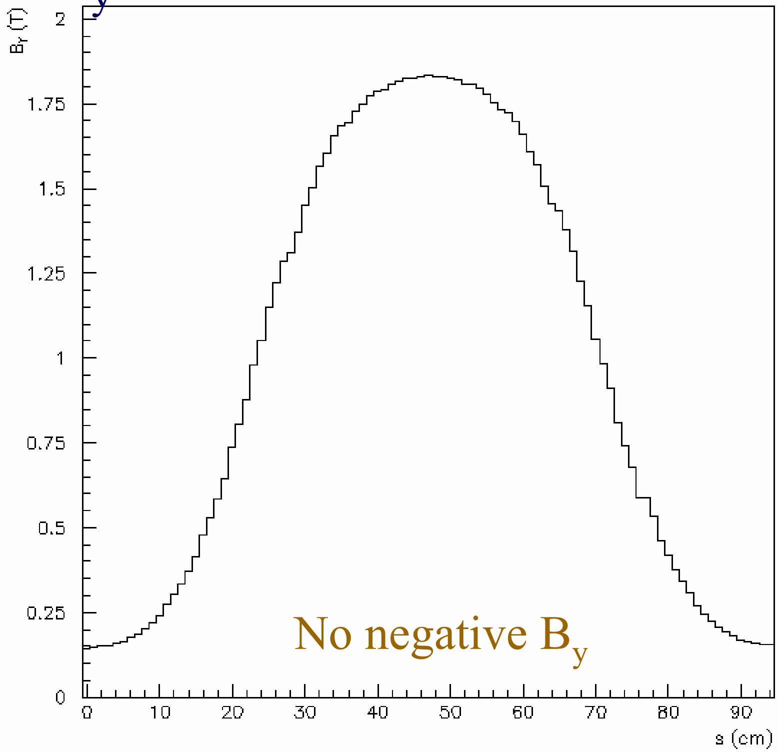
For E_{μ}~200 MeV, the radius should be ~60 cm

Field map with shaped iron poles (S. Kahn)

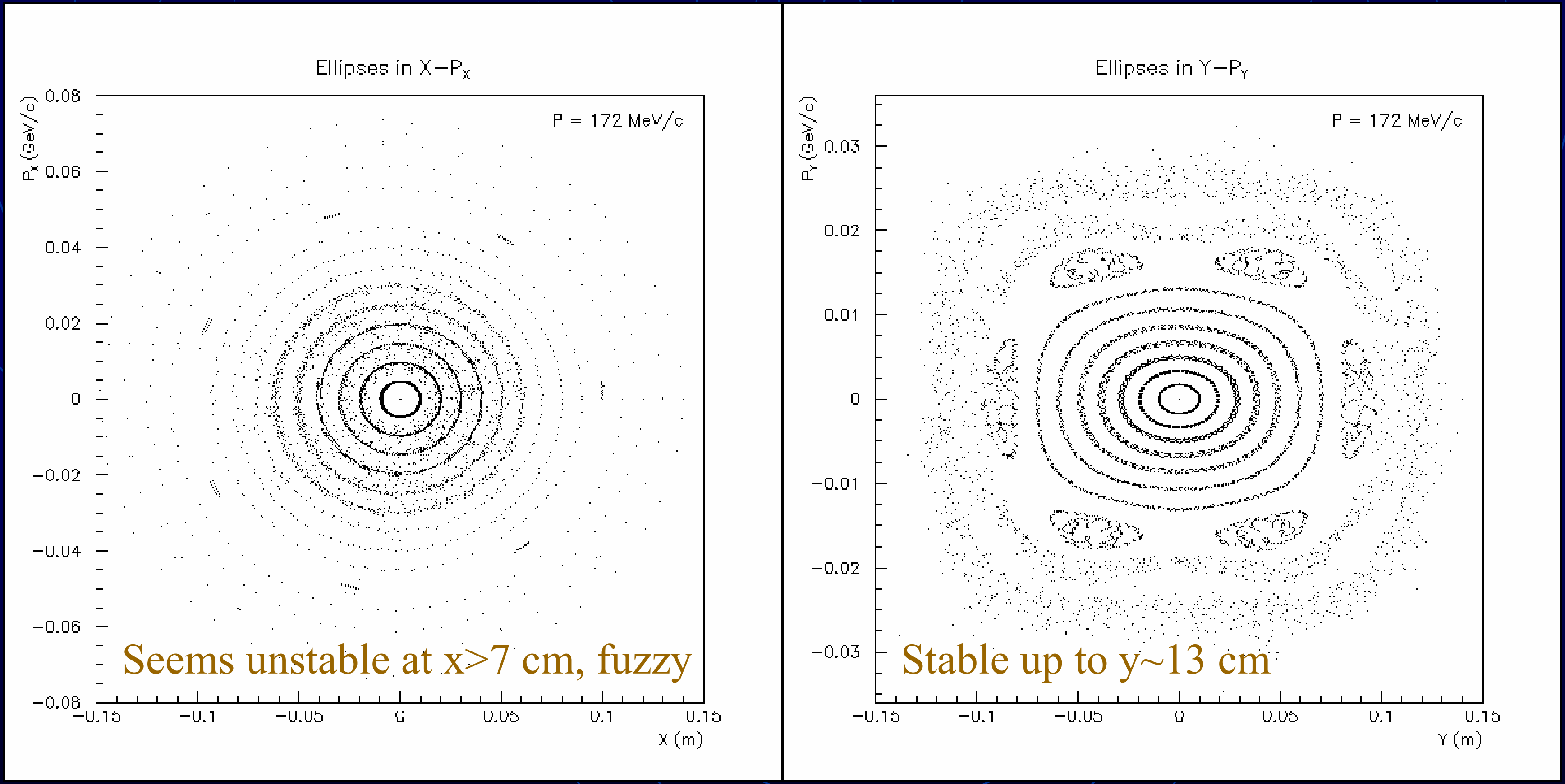
B_y in a single quadrant



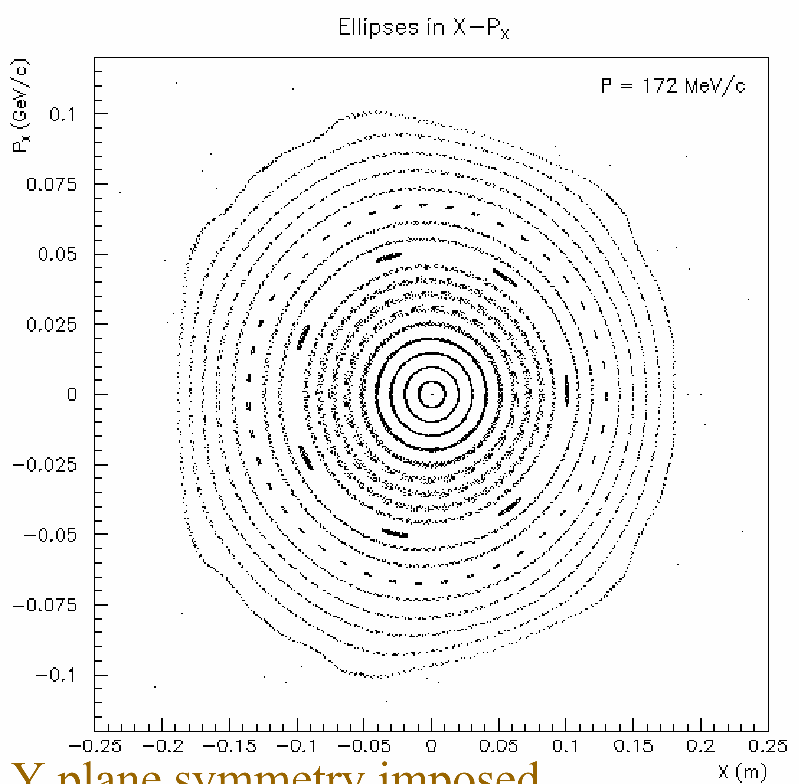
B_y at R=60 cm



Dynamic aperture as presented at Berkeley



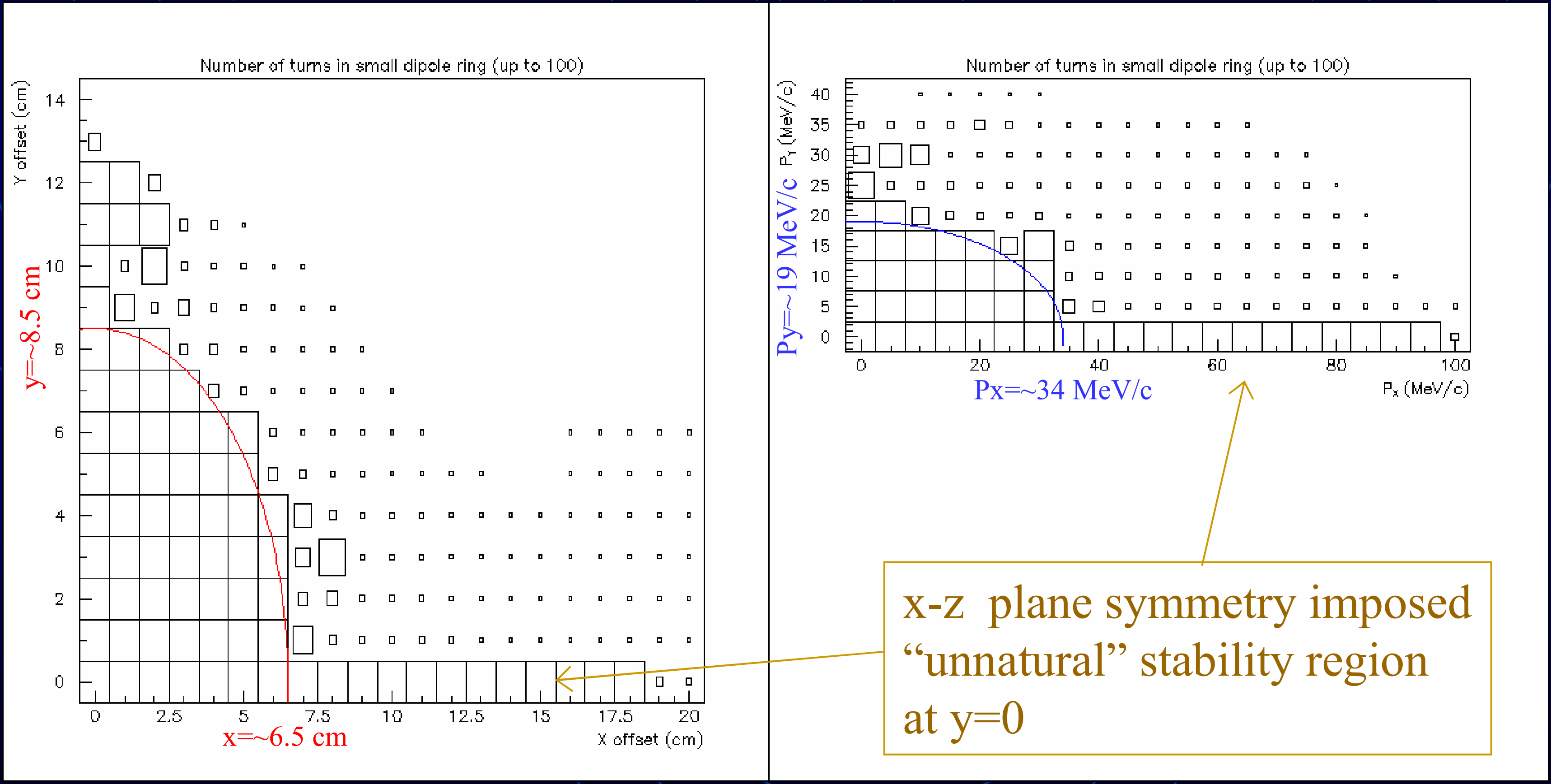
Solving the x aperture mystery



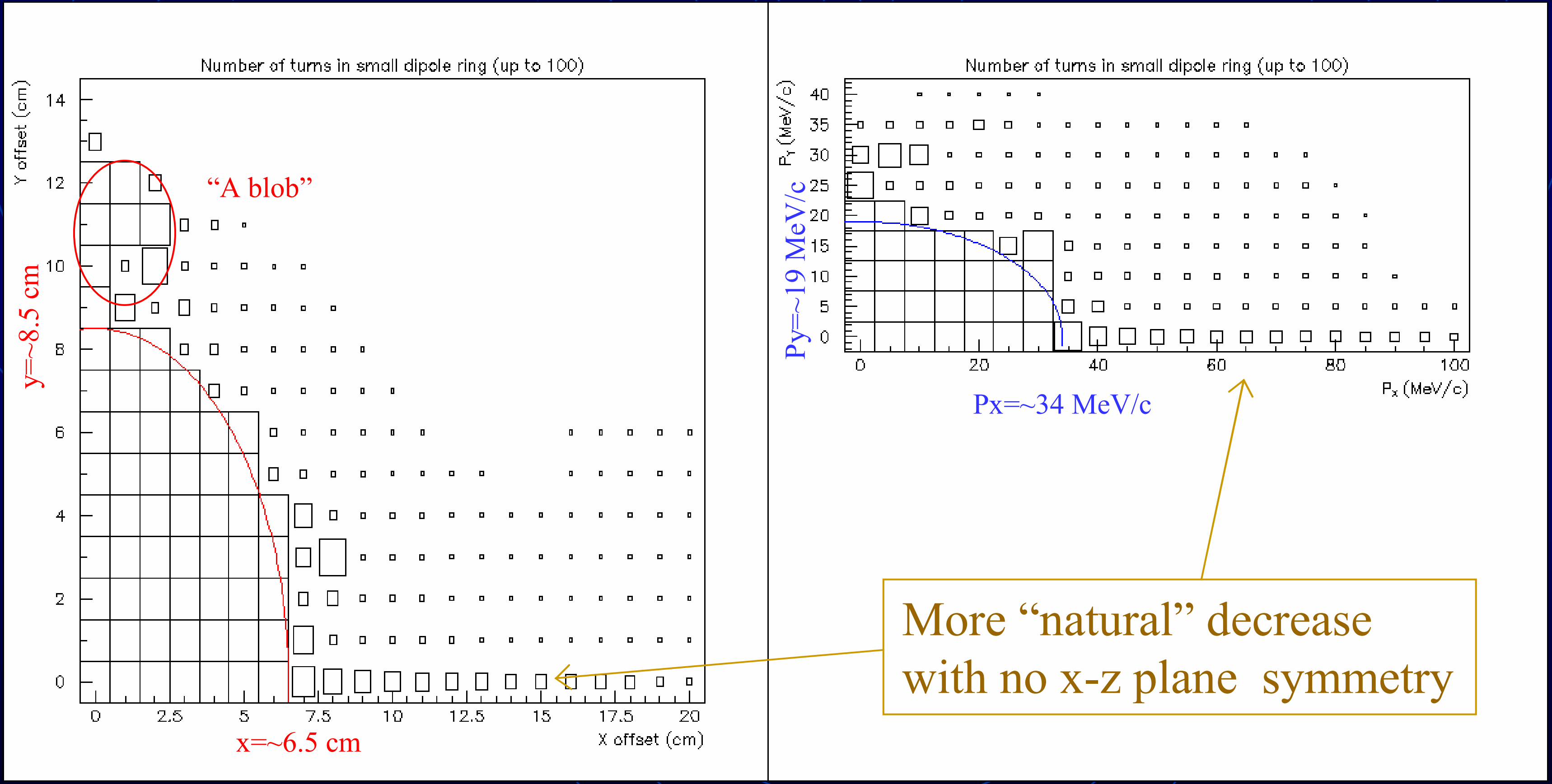
Y plane symmetry imposed

- The instability was due to small fluctuations in B_x, B_z at y=0
- The solution: impose Bx=Bz=0 at y=0 (perfect symmetry)
- The ring is stable up to x=18 cm !!

Transverse acceptance of the ring



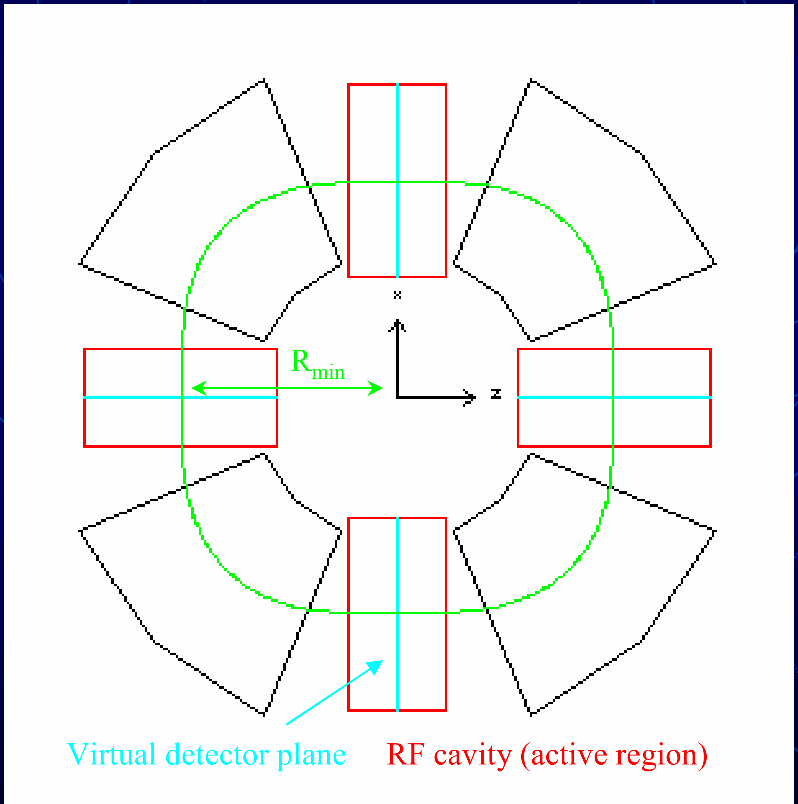
Transverse acceptance, without the y=0 symmetry



Find the reference particle

- Orbit period ~ 3rd harmonic of 201.25 MHz
- To be consistent with other studies (H. Kirk, S. Kahn):
  - P~170 MeV/c
  - R_{min}~55 cm

Reference particle



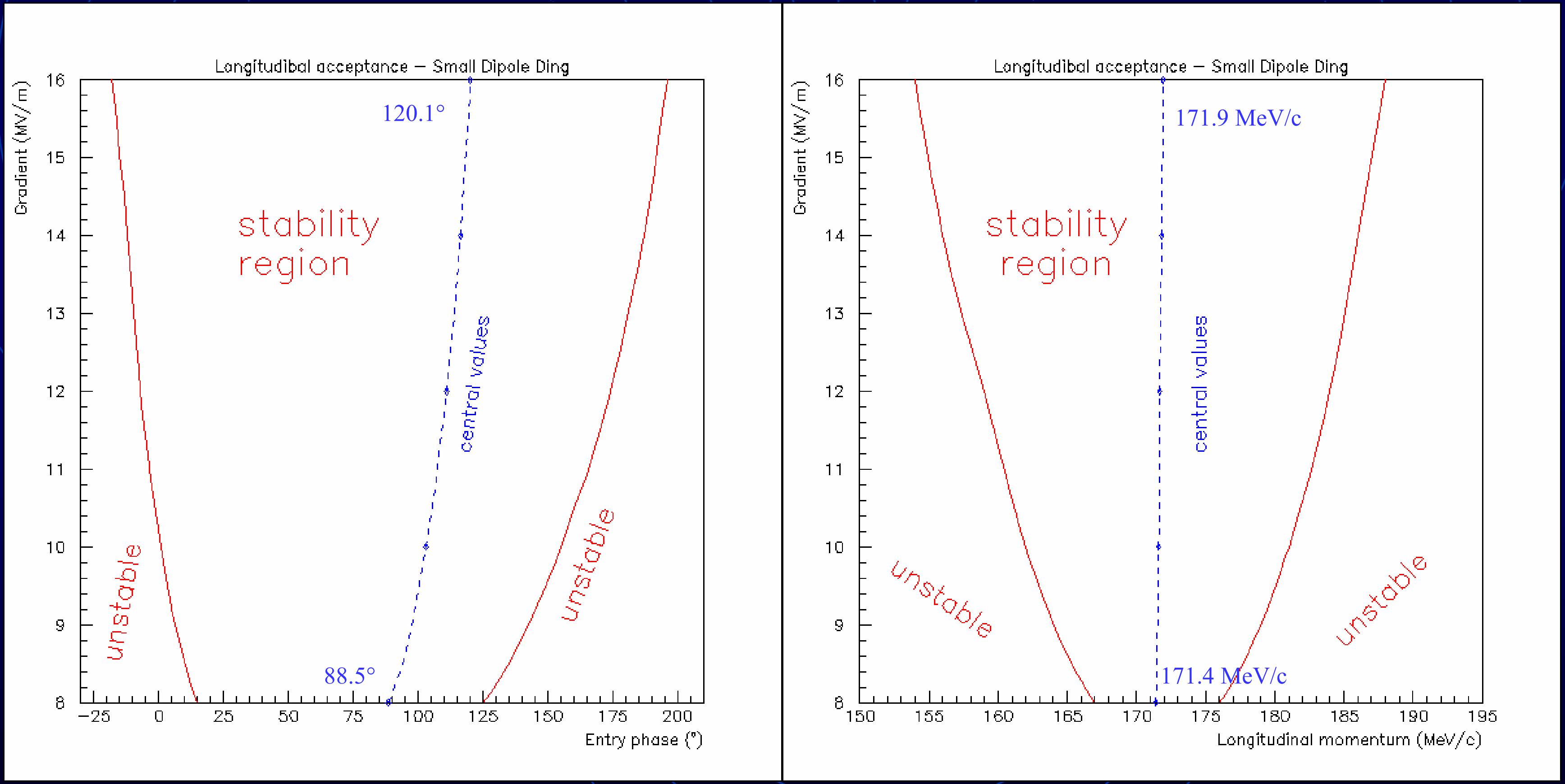
- Scale **B** down by 10%
  closed orbit:
- P=171.25 MeV/c
- R_{min}=56.32 cm
  (x=0 in virtual detectors)

Acceptance studies (pages 8, 9 above) were done with scaled-down B fields

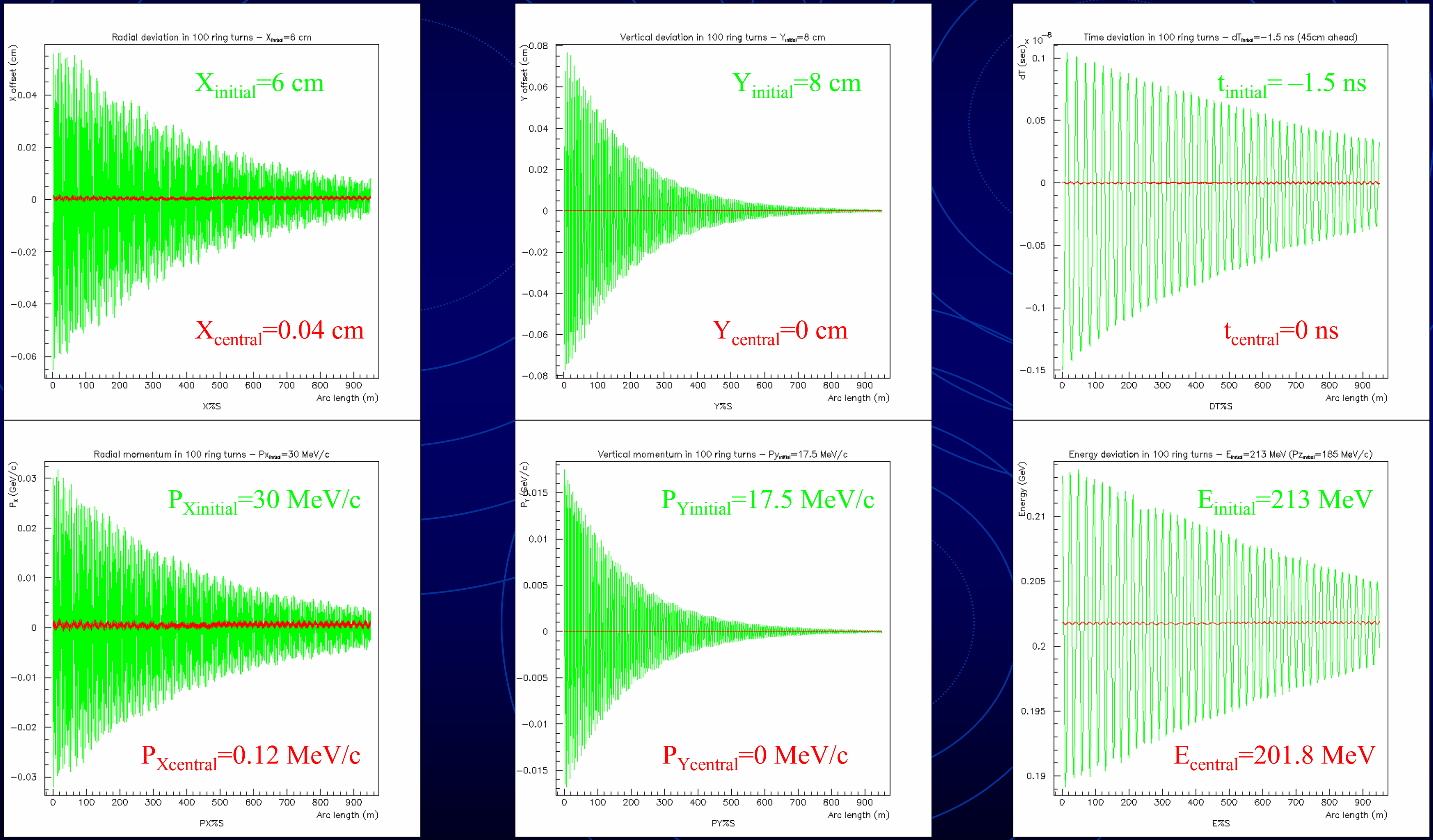
Add RF and “ideal” absorber

- The RF cavity
  - Perfect pillbox: 25 cm long, 65 cm in radius
  - Center at R=66.32 cm (10 cm from ref. particle)
  - Active region: ±15 cm in y, ±25 cm in x centered at R=56.32 cm (10 cm off cavity center)
- The absorber
  - Gaseous H_2 at 40 Atm (room temperature) fills the whole volume
  - “Ideal” – scattering and straggling not simulated

Longitudinal acceptance higher RF gradient – better



6D cooling with ideal absorber



To do

- Simulate cooling with realistic absorber
- Use beam (“standard” beam may not fit)
- Add cavity windows
- Full simulation of the demonstration ring:
  - Injection, either through dE/dx or pion decay
  - Detector planes – scifi
  - …

Conclusion

- Small Dipole Ring
  - So far, no cooling simulations with GEANT
  - Dynamic aperture improved with shaped iron poles, especially in y (realistic field maps from S. Kahn)
  - The goal: simulate the 6D cooling demonstration ring with realistic features